

CLAIMS:

1. A variable valve timing control device comprising:
 - a driving side rotational member rotating synchronized with a crankshaft;
 - a driven side rotational member positioned coaxially with the driving side rotational member, the driven side rotational member rotating with a camshaft;
 - a rotational phase holding mechanism for holding a relative rotational phase between the driving side rotational member and the driven side rotational member at a locked phase;
 - a rotational phase restriction mechanism for allowing a relative rotation that the relative rotational phase approximate to the locked phase and for restricting the relative rotation that the relative rotational phase being separated from the locked phase;
 - a groove formed at one of the driving side rotational member and the driven side rotational member;
 - a restriction body provided at the rotational phase restriction mechanism for restricting the relative rotation by moving from the other of the driving side rotational member and the driven side rotational member to be received at the groove;
 - a plurality of said rotational phase restriction mechanisms for restricting the relative rotation in a predetermined direction at different relative rotational phases;
 - a step portion provided at the groove serving as a part of at least one of the rotational phase restriction mechanisms being engaged with the restriction body for restricting the relative rotation in the predetermined direction; and
 - the rotational phase restriction mechanism including the step portion for restricting the relative rotation in the predetermined direction at the plural relative rotational phases.
2. The variable valve timing control device according to Claim 1, wherein the rotational phase holding mechanism includes the plural rotational phase restriction mechanisms.
3. The variable valve timing control device according to Claim 1, wherein the groove is formed at said the other of the driving side rotational member and the driven side rotational member in a radial direction so that the restriction body moves in the radial direction to be received at the groove.

4. The variable valve timing control device according to Claim 1, wherein the relative rotational restriction is applied in order by the different rotational phase restriction mechanisms for stepwise restricting the relative rotation in the predetermined direction at the plural different relative rotational phases.

5. The variable valve timing control device according to Claim 1, wherein the rotational phase restriction mechanism includes a first rotational phase restriction mechanism and a second rotational phase restriction mechanism serving as a pair of rotational phase restriction mechanisms; and wherein the relative rotational restriction is consecutively applied at different relative rotational phases in order of the step portion of the first rotational phase restriction mechanism, the step portion of the second rotational phase restriction mechanism, and the groove portion configured to be deeper than the step portion of the first rotational phase restriction mechanism.

6. The variable valve timing control device according to Claim 1, the rotational phase restriction mechanism for applying the stepwise restriction at different relative rotational phases in the same direction; wherein the rotational phase restriction mechanism applies the stepwise restriction at the different relative rotational phases in accordance with a rotation of the camshaft.

7. The variable valve timing control device according to Claim 1, wherein the restriction body moves at a path to approximate to over the groove to be received at the groove,
further comprising:
a guiding passage for guiding the restriction body, the guiding passage provided at a first rotational member surface position at the path, the first rotational member surface position determined at further groove inside than a second rotational member surface position provided at an extended path extended from said path.

8. The variable valve timing control device according to Claim 5, wherein the restriction body moves at a path to approximate to over the groove to be received at the groove,

further comprising:

a guiding passage for guiding the restriction body, the guiding passage provided at a first rotational member surface position at the path, the first rotational member surface position determined at further groove inside than a second rotational member surface position provided at an extended path extended from said path.

9. The variable valve timing control device according to Claim 7, wherein the restriction body serving as a part of at least one of the rotational phase restriction mechanisms contacts a surface of the guiding passage to move to approximate to over the groove; wherein the plural rotational phase restriction mechanisms include the restriction body respectively.

10. The variable valve timing control device according to Claim 1, wherein the step portion is configured stepwise.

11. The variable valve timing control device according to Claim 2, wherein each rotational phase restriction mechanism includes the step portion.

12. The variable valve timing control device according to Claim 8, wherein the guiding passage is provided at an intermediate position between a pair of rotational phase restriction mechanisms.

13. The variable valve timing control device according to Claim 8, wherein the grooves are provided at the first rotational phase restriction mechanism and the second rotational phase restriction mechanism respectively; and wherein the guiding passage is provided at one of the grooves side receiving the restriction body at an initial stage.

14. A variable valve timing control device according to Claim 1, wherein the plural relative rotational phases determined by restricting the relative rotation includes varied rotational phase differences different from one another.

15. A variable valve timing control device according to Claim 14, wherein the rotational phase difference is varied from a small phase difference at an initial state to be increased in order.